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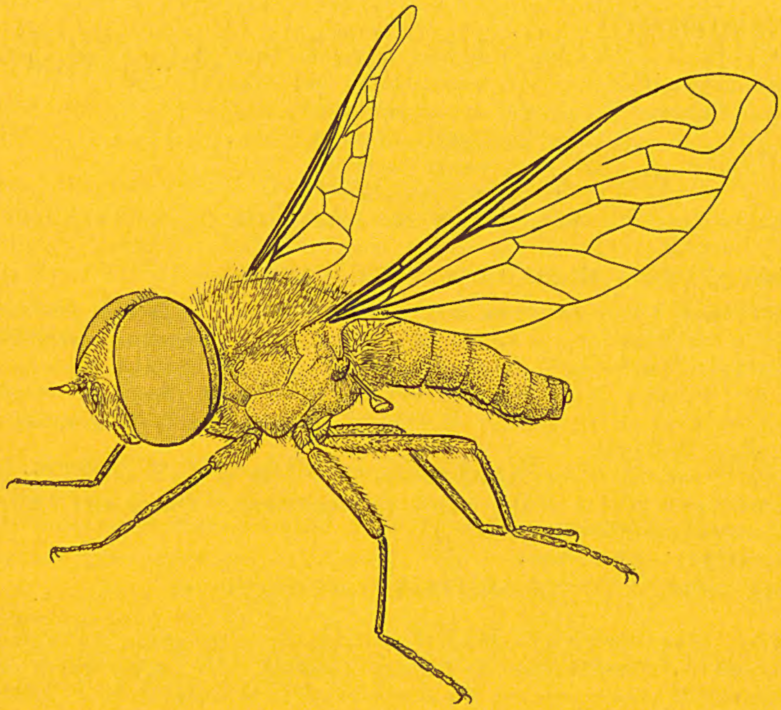

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Cover: This undescribed species of Bombyliidae of the genus *Docidomyia* is from the Goldfields Region of Western Australia. The genus belongs to the subfamily Tomomyzinae, and has closest relatives in southern Africa and North America. Adults feed on nectar and pollen and the larvae are presumably parasitoids as are most other Bombyliidae, although nothing is known of the life history of this subfamily throughout the world. Illustration by David Yeates.

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NOTES ON THE DISTRIBUTION AND IDENTITY OF *TIPHIA INTRUDENS* SMITH (HYMENOPTERA: TIPHIIDAE)

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Abstract

Specimens of *Tiphia intrudens* Smith (= *T. i. brevior* Turner, syn. nov.) ranging from India to south-eastern Queensland were examined. Although fore wing venation showed some variation in the female, no evidence of geographical variation was found and the use of subspecific names cannot be justified. This species, within Australia, is now known to range from Darwin to Brisbane.

Introduction

The genus *Tiphia* Fabricius is represented in Australia by a single species, *Tiphia intrudens* Smith. This species was originally described from Mysol (now Misool) Island, Indonesia, and was considered to range from India to north Queensland (Bingham 1897, Turner 1908), although no mention of this species was made by Allen (1975) in his monograph of the Indian subcontinent's species.

Turner (1908) placed Australian specimens as *T. intrudens brevior* Turner on the basis of a shorter propodeum in the female and paler wings in both sexes.

Abbreviations: ANIC, Australian National Insect Collection, CSIRO, Canberra; MV, Museum of Victoria, Melbourne; NHM, Natural History Museum, London; OUM, Oxford University Museum, Oxford; QDPI, Queensland Department of Primary Industries, Brisbane; QM, Queensland Museum, Brisbane; UQIC, University of Queensland Insect Collection, Brisbane.

Tiphia intrudens Smith
(Figs 1-7)

Tiphia intrudens Smith, 1863: 25; Bingham, 1897: 61; Allen and Jaynes, 1930: 103.

Tiphia intrudens brevior Turner, 1908: 123; Illingworth 1921:39. Syn. nov.

Tiphia (Tiphia) intrudens: Allen, 1969: 375.

Types. *Tiphia intrudens intrudens*: Lectotype ♀, Mysol, OUM. Paralectotypes: 1 ♂, 1 ♀, same data as lectotype, NHM.

Tiphia intrudens brevior: Syntypes 8 ♂♂, 5 ♀♀, Mackay, i.1893 to xii.1900, NHM; 1 ♂, Kuranda, xii.1901, NHM.

Material examined - Paralectotypes of *T. intrudens intrudens*, syntypes of *T. intrudens brevior* and other specimens as follows: INDIA: 1 ♂, Shillong, Assam, vi.1903, R. Turner, NHM; 1 ♂, Naga Hills, Bingham, NHM. BURMA: 1 ♂, Rangoon district, vii.1887, Bingham, NHM; 1 ♂, Tenasserim, Ataran Valley, Bingham, NHM; 1 ♂, Shwegyia, ix.1897, Bingham, NHM; 1 ♀, Goteik Gorge,

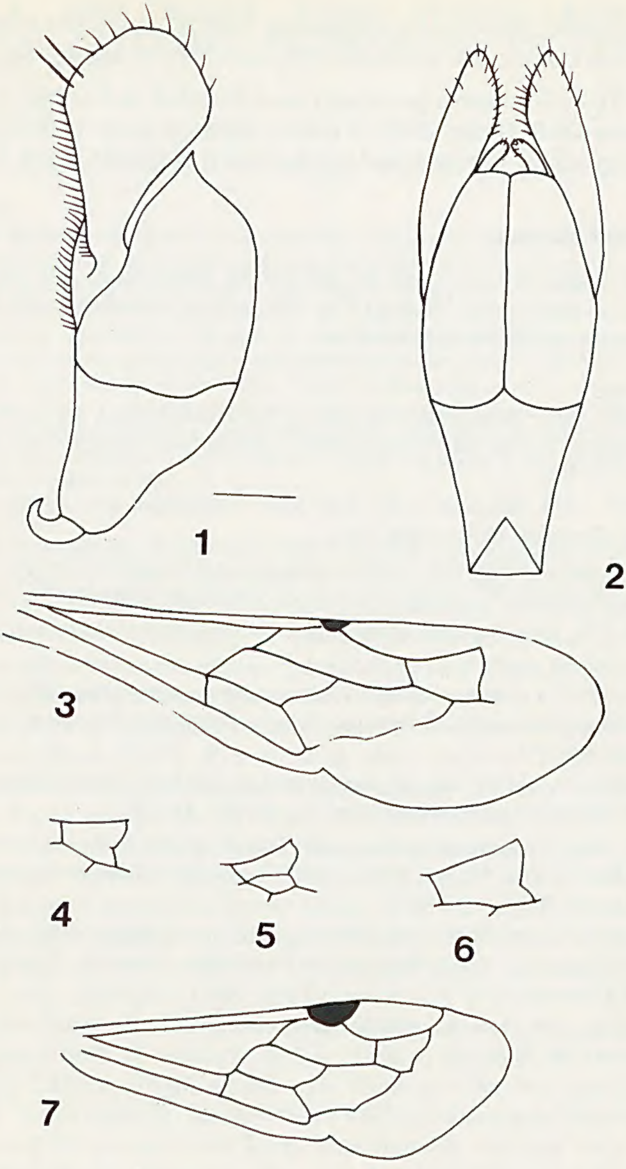
26.vii.1900, Bingham, NHM; 1 ♂, May Myo, 2,000 ft (610 m), 5.ix.1898, Bingham, NHM. INDONESIA: 1 ♂, 1 ♀, Mysol, NHM. PAPUA NEW GUINEA: 1 ♂, Ishurava, 3,000 ft (914 m), vii.1933, L.E. Cheesman, NHM. NORTHERN TERRITORY: 1 ♀, Port Darwin, R.C.L. Perkins, NHM. QUEENSLAND: 1 ♂, north Queensland, R.C.L. Perkins, NHM; 1 ♂, Iron Ra., 1-9.vi.1971, S.R. Monteith, ANIC; 1 ♀, 15°03'S, 145°09'E, 3 km NE of Mt Webb, Malaise trap, 1-3.x.1980, J.C. Cardale, ANIC; 1 ♂, 15°04'S, 145°07'E, Mt Webb Nat. Pk, 27-30.iv.1981, ANIC; 1 ♂, 15°16'S, 144°59'E, 14 km W by N of Hope Vale Mission, 8-10.x.1980, J.C. Cardale, ANIC; 1 ♂, 15°17'S, 145°13'E, 1 km N of Rounded Hill, nr Hope Vale Mission, 8-10.x.1980, J.C. Cardale, ANIC; 1 ♂, Big Mitchell Ck, Mareeba-Mt Molloy Rd, 4.v.1967, D.H. Colless, ANIC; 1 ♀, Luster Ck, 8 km W by N of Mt Molloy, 21-22.v.1980, I.D. Naumann and J.C. Cardale, ANIC; 1 ♂, 1 ♀, Carr Ck, 18 km NNW of Mareeba, 21.v.1980, I.D. Naumann and J.C. Cardale, ANIC; 1 ♂, Kuranda, xii.1901, NHM; 1 ♂, 1 ♀, Kuranda, F.P. Dodd, QM; 1 ♂, 1.5 km SE of Kuranda, 15-17.v.1980, I.D. Naumann and J.C. Cardale, ANIC; 1 ♂, 4 ♀, Meringa, 21.vi.1925, 27.vi.1925, 5.vii.1925, 5.ix.1925, 14.ii.1927, A.N. Burns, MV; 2 ♀, Gordonvale, 26.vii.1923, W.C. Dorner, QDPI; 1 ♂, Evelyn, ex oil bath trap, 18.iv.1967, R.J. Elder, ANIC; 1 ♂, 17°41'S, 145°26'S, Millstream Falls Nat. Pk, 24-25.v.1980, I.D. Naumann and J.C. Cardale, ANIC; 1 ♂, Dunk I., viii.1927, H. Hacker, QM; 2 ♀, Dunk I., 25.viii.1927, UQIC; 1 ♀, 15 mi. (24 km) S of Ayr, 8.ix.1950, E.F. Riek, ANIC; 1 ♀, Skywindow Lookout, Eungella Nat. Pk, 8-9.v.1980, I.D. Naumann and J.C. Cardale, ANIC; 10 ♂, 7 ♀, Mackay, i.1893-xii.1900, ANIC, NHM, QM; 3 ♂, Mackay, 17.iii.1929, 21.iii.1930, A.N. Burns, MV; 1 ♀, Murchies Scrub, Watalgan Forest, 9 km off Rosedale Rd, 1.xii.1973, H. Frauca, ANIC; 1 ♂, Watalgan R. via Rosedale, 8.iv.1975, H. Frauca, ANIC; 1 ♀, Electra State Forest, c. 25 km S of Bundaberg, 1.xii.1976, H. Frauca, ANIC; 6 ♂, Balfour Ra., nr Benarkin, sweeping vegetation, rainforest margin, 2-3.iii.1974, I.D. Naumann, UQIC; 1 ♂, Deception Bay, 23.v.1940, E.M. Exley, UQIC; 1 ♂, Brisbane, 23.iv.1916, H. Hacker, QM; 1 ♀, Currumbin, 9.xii.1965, C. Speed, UQIC.

Results and Discussion

Among the specimens examined there are no differences in the length of the female propodeum or in the male genitalia (Figs 1-2). There are slight differences in the colour of wings but, in the paralectotypes at least, the darkness is due to dirt rather than pigmentation. For these reasons the use of formal subspecific taxa cannot be justified and the Australian material should be referred to as *Tiphia intrudens* Smith.

The fore wings show considerable variation, particularly in the structure of the second submarginal cell of the female (Figs 3-7). This variation is not geographical and varies between left and right wings from the same specimen.

Allen (1969) doubted that any species of Hymenoptera could range from India to Australia. Examples which contradict this statement include the formicid *Oecophylla smaragdina* Fabricius, which ranges from east Africa to Australia (Taylor and Brown 1985) and the pompilid *Pompilus cinereus* (Fabricius), which is widespread in the Old World (Day 1981). At least one other



Figs 1-7. (1) male genitalia, lateral; (2) male genitalia, dorsal; (3) right fore wing, female; (4-6) variation in second submarginal cells of right fore wing, females; (7) right fore wing, male. Scale line = 0.2 mm (Figs 1 and 2) and 1 mm (Figs 3-7).

Australian tiphiid, *Rhagigaster fulvipennis* Turner, ranges from Queensland to Papua New Guinea, Aru Island and Indonesia (Brown unpublished).

Although *Tiphia intrudens* previously was recorded in Australia only from North Queensland (Turner 1908), it is now known to occur in the coastal and adjacent regions of northern and north-eastern Australia, from Darwin to Brisbane.

Acknowledgments

I wish to thank the curators of the above institutions for the loan of specimens in their care, Michael Day for helpful comments and Josephine Cardale for an initial list of references.

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LARVAL AND ADULT FOOD PLANTS FOR SOME TROPICAL SATYRINE BUTTERFLIES IN NORTHERN QUEENSLAND

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Abstract

A list of larval and potential larval food plants for six species of tropical Satyrinae is presented based on field observations in northern Queensland during 1989-93. Literature documenting larval foods for all Australian tropical Satyrinae is summarised. Larvae of two species, *Mycalesis perseus* (Fabricius) and *Melanitis leda* (Linnaeus), are recorded on many grasses and are probably opportunistic. Oviposition behaviour is briefly described; direct egg-laying on the leaves of the food plant appears characteristic for this group of butterflies. Comments are made on adult feeding for nine taxa. Nectar feeding appears to be widespread, except *Mycalesis* spp., and is particularly frequent in the smaller species *Ypthima arctous* (Fabricius) and *Hypocysta adiante* (Hübner). *Mycalesis terminus* (Fabricius) regularly feeds on rotting fruits, but *M. sirius* (Fabricius) does not seem to utilise this resource. *M. perseus* and *M. leda* may also feed on rotting fruits.

Introduction

The larval food plants of the Australian Satyrinae (Lepidoptera: Nymphalidae) are poorly known. This is particularly evident amongst the tropical species for which very little reliable information is available; for some taxa such as *Hypocysta adiante* (Hübner), *H. pseudirius* Butler, *Mycalesis perseus* (Fabricius) and *Orsotriaena medus* (Fabricius) no food plants are recorded from the field (Common and Waterhouse 1981). Waterhouse (1923) noted that the larval food plants of *Melanitis leda* (Linnaeus), *Ypthima arctous* (Fabricius), *Hypocysta metirius* Butler, *H. pseudirius* and *H. adiante* comprised grasses, while Manski (1960) listed *Imperata* (blady grass) and other course grasses (Poaceae) for seven species (*M. leda*, *Tisiphone helena* (Olliff), *Mycalesis terminus* (Fabricius), *M. sirius* (Fabricius), *Y. arctous*, *Hypocysta irius* (Fabricius), *H. metirius* Butler). The reliability of part of Manski's list, however, has been questioned by the failure of larvae of at least one taxon, *T. helena*, to accept *Imperata* as a food plant (Braby 1993), and Valentine (1988) has stated that *M. sirius* do not lay on this grass but prefer *Panicum maximum* Jacq. Edwards (1948) and Common and Waterhouse (1981) listed *Cynodon dactylon* (L.) Pers. (couch grass) for *H. metirius*, and De Baar (1981) reared both *H. adiante* and *Y. arctous* in captivity on *Imperata cylindrica* (L.) Beauv., *Digitaria didactyla* Willd. and *Themeda triandra* Forssk. (Poaceae). More recently, Moore (1986) studied oviposition behaviour in *M. terminus* and *M. perseus* and found that females oviposit on a range of grasses, although the two species showed substantial differences in selectivity with respect to food quality. Wood (1984, 1988) recorded the palm *Calamus caryotoides* Mart. (Arecaceae) for *Elymnias agondas* Boisduval and *Tetrarrhena* sp. (Poaceae) for both *Hypocysta angustata* Waterhouse & Lyell and *H. irius*,

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Table 1. Summary of larval food plants recorded for satyrine butterflies in northern Queensland, 1985, 1989-93. Number of records refers to the number of occasions in which the immature stages were recorded on that plant species. * = Species introduced to Australia. + = G. Moore (*pers. comm.*).

Satyrine species	Larval food plant	No. of records	Comments
Mycalesis perseus	*Themeda triandra* Forsskal	9	4 eggs laid, 3 larvae (instar IV-V), 2 pupal exuviae (Townsville, Cardwell)
"	*Dichanthium sericeum* (R.Br.) A. Camus	4	3 eggs laid, 2 larvae (instar IV) (Townsville)
"	*Heteropogon triticeus* (R.Br.) Stapf & Craig	2	2 eggs laid, 1 larva (instar V)
"	*H. contortis* (L.) Roemer & Schultes	1	1 egg laid+ (Townsville)
"	**Panicum maximum* Jacq.	2	1 egg laid, 1 larva (instar V) (Townsville, Rollingstone)
"	*Aristida calycina* R.Br.	1	1 egg laid+ (Townsville)
"	*Brachiara* sp.	1	1 egg laid+ (Townsville)
"	*Sporobolis* sp.	1	1 egg laid+ (Townsville)
"	*Eriachne* sp.	1	1 egg laid (Seaforth)
"	grass sp.1	1	2 eggs laid (Mt. Elliot Nat. Park)
"	grass sp.2	1	1 egg laid (Mt.Elliot Nat. Park)
Mycalesis terminus	*Oplismenus aemulus* (R.Br.) Roemer & Schultes	1	1 egg laid (Rollingstone)
"	*Oplismenus* sp.	4	6 eggs laid (Townsville, Bartle Frere)
"	*Dichanthium sericeum*	3	4 eggs laid, 1 larva (instar I) (Townsville)
"	**Panicum maximum*	2	5 eggs laid (Townsville, Rollingstone)
"	**Axonopus compressus* (SW.) P. Beauv.	1	3 eggs laid+ (Townsville)
"	*Themeda triandra*	1	1 egg laid (Cardwell)
"	grass sp.1	1	1 egg laid (Townsville)

Mycalesis terminus	grass sp.2	1	1 egg laid (Seaforth)
"	*Flagellaria indica* L. (Flagellariaceae)	1	1 egg laid (Wenlock River, C.Y. Peninsula)
Mycalesis sirius	*Themeda triandra*	2	8 eggs laid (Cardwell)
"	*Ischaemum australe* R.Br.	2	8 eggs laid (Rollingstone)
"	**Panicum maximum*	1	1 egg laid (Cardwell)
"	grass sp.	1	1 egg laid (Cardwell)
Melanitis leda	**Panicum maximum*	5	all stages (Townsville, Cape Cleveland, Majors Creek, Kennedy)
"	*Imperata cylindrica* (L.) P. Beauv.	3	1 egg laid, 23 larvae (various instars) (Kennedy, Cape Cleveland, Cardwell)
"	*Ophiuros exaltatus* (L.) Kuntze	3	all stages (Mt. Elliot Nat. Park, Cardwell)
"	*Themeda triandra*	3	4 eggs laid, 1 pupal exuvia (Mt. Elliot Nat. Park, Townsville, Byfield)
"	*Heteropogon triticeus*	2	1 pupa, 2 pupal exuviae (Cardwell)
"	**Melinis minutiflora* P. Beauv.	1	20 larvae (Kennedy)
"	*Sorghum* sp.	1	3 eggs (Cape Cleveland)
"	*Chrysopogon* sp.	1	1 larva (instar V) (Innot Hot Springs)
"	*Paspalidium* sp.	1	2 eggs laid (Byfield)
"	grass sp.	1	1 larva (instar V) (Townsville)
Hypocysta metirius	*Eriachne pallescens* R.Br.	1	3 eggs laid (Paluma)
"	grass sp.	1	2 eggs laid (Paluma)
Hypocysta adiante	*Themeda triandra*	1	1 egg laid (Cardwell)

while Braby (1993) confirmed that the sedge *Gahnia sieberiana* Kunth (Cyperaceae) is the natural food plant of *T. helena*. For *M. leda*, De Baar (1983) and Hawkeswood (1990) recorded larvae on *Panicum maximum*, the latter author also reared larvae on *Paspalum dilatatum* Poir. (Poaceae), while S.J. Johnson (*in* Dunn and Dunn, 1991) listed *Sorghum verticilliflorum* (Steudel) Stapf. Waterhouse (1932) and Common and Waterhouse (1981) also listed paspalum, buffalo grass (*Stenotaphrum secundatum* (Walter) Kuntze), blady grass (*Imperata* sp.), millet and sugar cane (*Saccharum* sp. probably *officinarum*) for *M. leda*. Dunn (1993) recently added *Leersia hexandra* Swartz for *M. leda*.

In this paper a list of larval food plants for six tropical satyrines is presented. Comments are also made on adult feeding behaviour. The records contribute substantially to the biology and natural history of these butterflies.

Materials and methods

The records presented on larval and adult food plants were based mainly on incidental observations during extensive field studies throughout northern Queensland, from Rockhampton to Cape York, in 1989-93. Observations were obtained for 10 of the 14 satyrines which occur in this region, the four species for which no records were made were *E. agondas*, *O. medus*, *H. angustata* and *Heteronympha merope* (Fabricius). Many of the larval records were made whilst watching ovipositing females, particularly between Townsville and Cardwell. The food plant records are presented in summarised form[1] and include Moore's (1985) unpublished work for two species studied at Townsville. Larval food records for *Tisiphone helena* are excluded as these are presented elsewhere (Braby 1993). Detailed observations were also made on adult feeding behaviour, and these are commented upon in only general terms[1]. A feeding record was defined where an individual(s) was observed to visit a food source for at least 5 sec. and uncoil the proboscis into the food.

Results

Larval food plants

Observations on larval foods (comprising 69 records in total) were obtained for six species, viz. *M. perseus*, *M. terminus*, *M. sirius*, *M. leda*, *H. adiante* and *H. metirius*, and these are summarised in Table 1. The immature stages of the first four species were recorded on a wide range of grasses, while only one or two observations were made for *H. adiante* and *H. metirius*. The larval diets of two species, *M. perseus* and *M. leda*, were broad with 11 and 10 grass species recorded respectively. *M. perseus* appeared to favour *Themeda triandra* (37.5% of all records for this species), while *M. leda* appeared to favour *Panicum maximum* (23.8% of all records for this species); on one occasion over 100 larvae were counted on this plant. Only eggs were recorded

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A more detailed list including information on locality, date and time of observation for each record is available on request from the author.

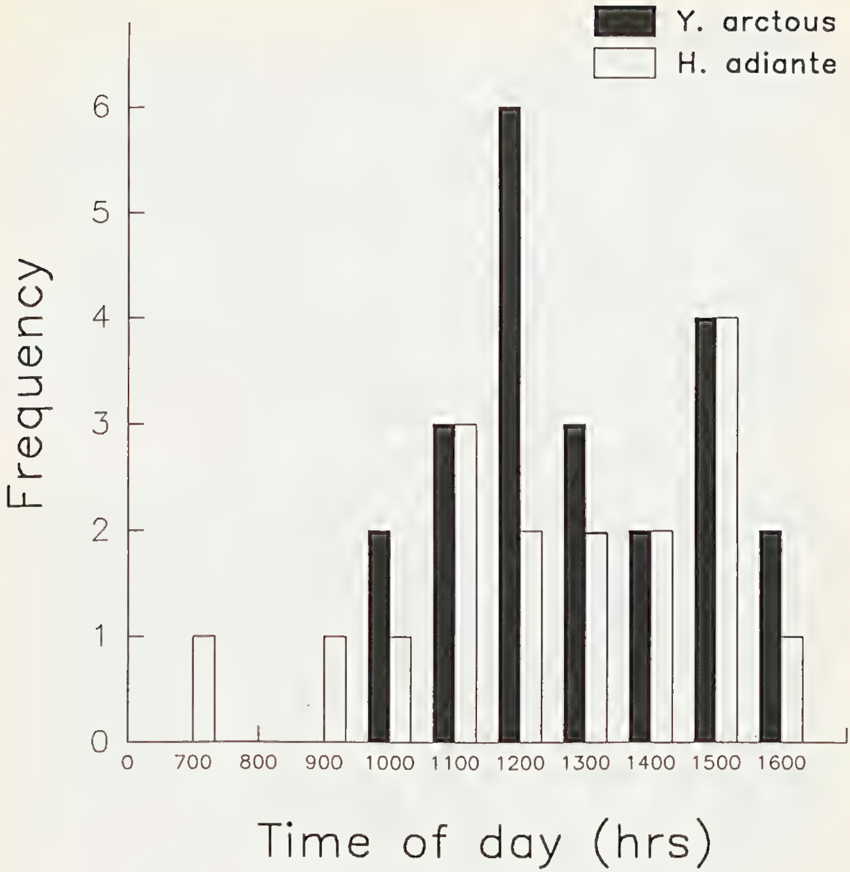

Fig. 1. Diurnal frequency distribution of the number of records of nectar feeding in two adult satyrines, *Ypthima arctous* and *Hypocysta adiante*. Feeding records are grouped into hourly intervals.

for the remaining four satyrines, and their larval plant preferences cannot be inferred from the few egg-laying observations. *M. terminus* may favour *Oplismenus* spp. (33% of all records for this species), grasses which grow in damp areas in rainforest edges where the butterfly typically occurs. One observation was also made of a female *M. terminus* ovipositing on the rainforest grass-like vine *Flagellaria indica* (Flagellariaceae). Although only two records were obtained for *M. sirius* on *Ischaemum australe*, this may be an important food plant because the grass grows commonly in the paperbark swamplands where adult *M. sirius* typically occur (Braby 1995a): on one

occasion seven eggs were deposited on this grass by several females over a 13 minute observation period.

In all species where eggs were found or where egg-laying was observed, females generally deposited their eggs singly on the underside of green grass blades, usually on younger (softer) growth, although *M. terminus* and *M. sirius* appeared less selective in this regard. *M. leda* usually deposited its eggs in small groups of up to five. Most butterfly females alighted on the leaf above and curled the abdomen underneath the leaf to oviposit. *M. leda* was an exception to this behaviour in that the females would orientate themselves under the leaf and hang upside down while laying. In *M. perseus*, *M. terminus* and *M. sirius* most oviposition observations were recorded in the afternoon and only one *M. terminus* female was observed to lay in the late morning; two eggs were laid at Rollingstone during overcast conditions. Eggs were laid only at dusk in *M. leda*.

Adult food plants

Adult feeding was observed in nine satyrine species (with 65 records obtained in total), viz. *M. perseus*, *M. terminus*, *M. sirius*, *Y. arctous*, *H. adiante*, *H. metirius*, *H. irius*, *H. pseudirius* and *T. helena*, but was not recorded in *M. leda*. Nectar feeding was widespread and particularly common in the smaller species *Y. arctous* and *H. adiante*. These two butterflies were observed feeding on flowers from a wide range of plant families and combining all records on a diurnal basis revealed that feeding occurred throughout the day, though more often in the afternoon or at midday than during the early morning, particularly in *Y. arctous* (Fig. 1). Nectar feeding appeared less common in *H. metirius* (5 records), was rarely observed in *H. irius*, *M. perseus*, *M. sirius* and *T. helena* (with 3, 3, 1 and 1 records for each respectively) and was not recorded at all in *M. leda* and *M. terminus*. Only two records of nectar feeding were obtained for *H. pseudirius*, but the few observations may reflect the fact that this species is comparatively rare in northern Queensland and consequently less frequently observed in the field.

M. terminus, by contrast, was often recorded feeding on fallen rotting fruits, including those of *Pandanas whitei* Martelli (Pandanaceae), introduced *Mangifera indica* L. (Anarcardiaceae), *Nauclea orientalis* (L.) L. (Rubiaceae) and *Ficus racemosa* L. (Moraceae); on several occasions large numbers of adults (>30) were observed feeding at these resources. On one occasion this species was also noted attending a sap flow of *Planchonia careya* (F. Muell.) Kunth (Lecythidaceae). *M. perseus* appeared to visit fallen rotting fruits less frequently than *M. terminus* and only two records of adult feeding were made (on *Mangifera indica* and *Pandanus* sp.). *M. sirius* and *M. leda* were not recorded feeding on rotting fruit, but the latter species has been observed on occasions feeding on this resource (R.E. Jones, *pers. comm.*). Both *M. terminus* and *M. perseus* were also observed on several occasions to drink from droplets of water early in the morning.

Discussion

Caution must be taken in interpreting apparent preferences and diet breadth of larval foods from observations of this sort because the records are incidental and the sampling effort was not quantitatively distributed across potential foods or habitats. Moreover, most of the records were made while watching ovipositing females and therefore further caution should be taken over suitability of these species because butterfly females occasionally make 'mistakes' (Singer 1984 and references therein, Kitching and Zalucki 1983) so further work is needed to investigate various components of offspring fitness such as larval success. Nevertheless, limited observations suggest larvae do indeed feed on a range of plant species; in captivity I reared *Mycalesis* spp. larvae on several grasses including *Panicum maximum*, *Themeda triandra* (Braby and Jones 1994) and *Imperata cylindrica*, but late instars of these species also successfully accepted the sedge *Gahnia sieberiana*. This may indicate that larvae are broad opportunistic oligophages, though females probably rarely lay on Cyperaceae in the field.

The larval diet of at least two species, *M. perseus* and *M. leda*, appears particularly broad, especially in the latter species if the records are combined with all previously recorded food plants (see Introduction). [Many of the plants listed in Table 1 were recorded with larvae and pupae indicating successful development on these foods]. This relatively wide range may reflect their reproductive strategies; both species are opportunistic breeders during the wet season when grasses are green (Braby 1995b).

In contrast to many temperate northern hemisphere satyrines which rarely deposit their eggs on the leaves on which their larvae later feed (Wiklund 1984), the six satyrines for which observations were made deposited their eggs directly onto the leaves of the plants. The behaviour also occurs in another four Australian tropical satyrines (Wood 1984, 1988, Braby 1993). Most eggs were laid singly, but Moore (1985) found that *M. terminus* occasionally lays eggs in batches of up to seven. The apparently undiscriminating strategy of temperate species is thought to be a result of the super-abundant nature of their food plants (mostly grasses), because newly hatched larvae have a high probability of food encounter regardless of where eggs are laid (Wiklund 1984). However, since grasses are also super-abundant in tropical habitats there may be different selective forces operating on tropical satyrines and Moore (1986) has argued that greater available search time may have promoted a higher degree of selectivity in tropical species. There may also be differences in various ecological factors, such as food quality and the extent of predation/parasitism of eggs, between temperate and tropical habitats which could account for differences in the oviposition strategies adopted by these two satyrine groups.

Common and Waterhouse (1981) noted that the adults of Australian satyrines sometimes visit flowers to feed, but precise details have rarely been recorded.

Amongst the tropical species nectar feeding appears widespread and was particularly common in two species, *Y. arctous* and *H. adiante*. These butterflies were recorded feeding from a wide range of flowers, some of which are introduced, suggesting opportunistic behaviour. Apparent tendency of *Y. arctous* and *H. adiante* to feed more frequently around midday and afternoon may reflect sampling bias, daily variation in nectar flow, or more likely diurnal changes in butterfly activity patterns (Braby 1995a).

By contrast *M. terminus* does not appear to feed on nectar but seems to specialise on rotting fruits. Valentine (1982, 1988) has noted that *M. terminus* and also *M. leda*, are attracted to rotting fruit and that adults will feed for long periods from fallen mangoes or other soft fruits. The species also can be trapped regularly in the field by setting baits of rotting fruit (Moore 1985, Braby 1995a). This feeding behaviour, however, does not seem to occur in *M. sirius* and was recorded only on a few occasions in *M. perseus*. However, Moore (1985) and Braby (1995a) have found that *M. perseus* is often attracted to rotting fruit by baiting so that this resource may be a more important component in the adult diet of this species than present records indicate.

The significance of these dietary sources in the biology and reproductive ecology of these butterflies warrents further investigation. In *M. terminus* females, for instance, availability of rotting fruit in the adult diet appears to play an important role in producing better quality offspring (Braby and Jones 1995).

Acknowledgments

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RESEARCH REQUEST

REVISED BOOK ON THE BUTTERFLIES OF AUSTRALIA

During the next two years Michael Braby, Ted Edwards and Ebbe Nielsen of the Lepidoptera Unit, Australian National Insect Collection, with support from CSIRO, will be collating all available information on Australian butterflies to produce a fully revised handbook to replace the now outdated 1981 edition of I.F.B. Common and D.F. Waterhouse's Butterflies of Australia.

The new book will summarise all published (and unpublished) knowledge on the taxonomy and biology of each of the 400 or so species, and will be richly illustrated with new colour plates. It will be of larger format with a strong emphasis on user-friendly identification, highlighting distinguishing features to separate similar and closely-related species, and to separate males and females. The text for each species will include informative reviews on geographical variation and subspecies, larval food plants, attendant ants, life cycle and behaviour, and distribution and status. In addition, there will be brief description of the immature stages and a list of key references for further reading. The water colour plates, first prepared by N.W. Cayley for G.A. Waterhouse's classic *What Butterfly is That?* published in 1932, will be replaced with high quality photographic plates of set specimens. We envisage that, for each species, the plates will depict the upperside and underside of each sex and most subspecies.

We are appealing to butterfly collectors and other entomologists to assist with this important project. In particular we seek your support with loans of specimens, and new information on distribution, general biology, life histories and behaviour that you may wish to have included in the new book. All specimens loaned to us will be returned and all assistance with the project will be clearly acknowledged. Your help will be mentioned in the formal Acknowledgments section and where we incorporate unpublished information your name will appear as reference to that information in the text.

Please feel free to contact us for further information and any questions you may have.

Butterfly Project
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NEW EUPHORBIACEAE HOST RECORDS FOR THE ZODIAC MOTH *ALCIDES ZODIACA* BUTLER (LEPIDOPTERA: URANIIDAE)

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Abstract

Omphalea papuana Pax & K. Hoffm. and *Omphalea* sp. (Hazlewood Gorge, S.G. Pearson SP439) (Euphorbiaceae) are recorded as new hosts for *Alcides zodiaca* Butler. A breeding colony of *A. zodiaca* in the Eungella area is briefly described.

Introduction

Alcides zodiaca is a conspicuous and well-known day-flying moth found in north-eastern Queensland from the tip of Cape York south to Mackay. The life history of this moth has been described previously and recorded host-plants are *Endospermum medullosum* L.S.Sm., *E. myrmecophilum* L.S.Sm. and *Omphalea queenslandiae* F.M. Bailey (all Euphorbiaceae) (Coleman and Monteith 1981, Monteith and Wood 1987).

Observations

In this note we record two additional host plants.

(1) *Omphalea papuana* Pax & K. Hoffm. occurs in Australia and New Guinea, with the Australian records all from Iron Range. This species has only recently been recognised from Australia (Forster 1994) and previous records of *Omphalea* from Iron Range were misidentified as *O. queenslandiae*. *A. zodiaca* has been successfully reared on cultivated plants of *O. papuana* at Tolga.

(2) *Omphalea* sp. (Hazlewood Gorge, S.G. Pearson SP439) occurs at Hazlewood Gorge near Eungella and Gloucester Island near Bowen, both in central Queensland. Unlike the canopy lianes *O. queenslandiae* and *O. papuana*, this undescribed species is a small tree. A large and apparently permanent population of *A. zodiaca* has been observed at Hazlewood Gorge on four occasions: Dec. 1992, Jan. 1993, June 1994, July 1994. The adult moths are usually in close proximity to the host trees. In June 1994 all stages of development of the moth were observed on mature foliage of the *Omphalea* with larval behaviour and pupation similar to that described by Coleman and Monteith (1981). This breeding population at Hazlewood Gorge (or other undiscovered ones in the area) is undoubtedly responsible for the "Mackay" records of *A. zodiaca* (Coleman and Monteith 1981).

Acknowledgments

S.G. Pearson and M.C. Tucker assisted with observations of the Hazlewood Gorge population.

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BOOK REVIEW

Monographs on Australian Lepidoptera. Volume 3. Oecophorine Genera of Australia. 1.: by Ian F. B. Common. CSIRO Publications. Melbourne. 1994. 420 pp.

The Oecophorine moths are likely to be unfamiliar to most Australian entomologists, perhaps because of their lack of economic species. However, from a biodiversity point of view, they are an extremely important group: in Australia, there are more than 500 species in over 250 genera. A significant proportion of these are undescribed. The Australian fauna contains mostly endemic species, many of which utilise dead Eucalptus leaves as larval food, so this group of moths is likely to have an important role in the ecology of native forests. This latest monograph on Australian Lepidoptera is the first volume of a complete generic revision of the Oecophorinae. It treats the Wingia group of 91 genera, which encompasses over a third of the Oecophorine genera, and describes 35 new genera and 305 new generic combinations.

The taxonomic core of the book is prefaced by four short chapters on: phylogeny, morphology, biology, and diversity and distribution. The tentative phylogenetic analysis presented in Chapter 1 highlights our incomplete knowledge of the group. Chapter 2 provides the morphological background necessary for using and understanding the systematic account of the genera. Chapter 3 gives a summary of life histories, biology and pest status. There is a small but interesting section on collecting and rearing Oecophorinae. With so large and diverse a group, the opportunities available for providing new information from rearing the species is considerable and, with many species feeding on Eucalyptus leaf litter, rearing would seem to be particularly easy and rewarding. Chapter 4 (Diversity and Distribution) is the shortest in the book being only two pages of text but it gives a succinct overview of Oecophorine diversity around the world.

Chapter 5 provides the taxonomic revision of the *Wingia* group. It starts with a key to the genera and then provides a detailed description of each genus, along with information on distribution and biology, and a synonymic list of species referred to each genus. Although I have not yet had the chance to try the key, the characters appear to be clearly described, with the terminology well defined in Chapter 2 and there is frequent cross-referencing to text figures. The generic descriptions which follow are clear, concise and abundantly illustrated. The figures are high quality line drawings of wing venation, photographs of adults and male and female genitalia and scanning electron micrographs. The abundant illustrations are a key element of the book and whilst I prefer to see line drawings of genitalia, clearly their development for a monograph of this magnitude would be a daunting task.

This book is an impressive work and I hope it encourages others to further study this important group. Dr. Common is to be congratulated on its production and I await eagerly the two companion volumes.

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THE ROGADINE WASP GENUS *BATOTHECA* (HYMENOPTERA, BRACONIDAE) NEW TO AUSTRALIA

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Abstract

The parasitic wasp genus *Batotheca* Enderlein (Hymenoptera: Braconidae: Rogadinae) is recorded from Australia for the first time.

The Australian braconid wasp fauna has been largely neglected until quite recently when an improved knowledge of generic and subfamily level taxonomy has led to a spate of descriptions of new taxa and the discovery of many genera and higher level taxa on the continent for the first time.

During sorting of the Braconidae accessions in the Natural History Museum, London, a female specimen of the highly distinctive braconid wasp genus *Batotheca* Enderlein (1905) was found which bears the following labels: "G'vale W.A.MCO 7.11.27", "Gordonvale Australia" and "Br 154". It is not clear whether W.A. refers to Western Australia or to its collector. However, it seems likely that it is the latter as there is a Gordonvale in northern Queensland which is an important historical collecting site for parasitic Hymenoptera.

Previously *Batotheca* was known to occur from India through Indo-China and the Philippines to Papua New Guinea. *Batotheca* was revised by Watanabe (1938, 1958) who recognised four species. However, all the species are morphologically extremely similar and differ primarily in coloration so the possibility that these represent just colour variants of a single species cannot be excluded at present. The Australian specimen reported here has a reddish head and mesosoma and a black and white metasoma making it appear to be either *B. beccarii* (Mantero) or *B. dohrniana* Enderlein. The characters given to separate these by Watanabe (1938) were based on the literature rather than on the examination of many specimens and they do not take into consideration the range of variation that can be observed in large collections of Indo-Australian specimens. It would be unwise therefore to assign the Australian specimen to a particular species at present.

Batotheca species are koinobiont endoparasitoids of limacodid moth caterpillars which they mummify prior to pupating internally (Austin 1987). Some species may be economically important in that their hosts are pests (Greve and Ismay 1969, Conway and Tay 1969, Austin 1987).

Acknowledgment

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A PRELIMINARY INVESTIGATION OF THE CADDIS-FLIES (INSECTA: TRICHOPTERA) OF THE QUEENSLAND WET TROPICS

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Abstract

A checklist of the trichopteran fauna of the Queensland Wet Tropics is presented. The species composition of at least 217 taxa, including 95 new species and four new genera, is summarised and discussed with reference to the overall Australian fauna and available information on the Trichoptera fauna of several eastern Australian areas.

Introduction

The Queensland Wet Tropics (QWT), including the Wet Tropics World Heritage Area, lies along the east coast of Australia between Cooktown in the north and Townsville in the south, extending inland to the Atherton Tableland (Fig. 1.). Proclamation of the Wet Tropics World Heritage Area was recognition of the environmental significance and sensitivity and the cultural importance of the region. The Wet Tropics Management Authority funded several studies of the local fauna and flora and this paper summarises our findings on the Trichoptera fauna.

The study was based on material from 151 sites held in various Australian museum collections (22,549 specimens: 10,527 ♂♂, 9213 ♀♀, 2297 larvae and 512 pupae). Sites were grouped into investigation areas numbered 1-10 (Fig. 1), which enabled a preliminary assessment of regional variations in the Wet Tropics Trichoptera fauna, using the PATN programs Decorana and Twinspan (Belbin 1988). The criteria for grouping sites into investigation areas was latitudinal except for areas 4-7. These areas occupy similar latitudes but represent vastly different habitats. Investigation area 5 represents low coastal areas, while area 7 comprises sites on the Atherton Tableland. Investigation area 4 (Kuranda district) represents a region between the lowlands and the Atherton Tableland, while area 6 (Bellenden Ker and Mt Bartle Frere) represents high altitude sites.

Results

Taxa identified during this study are listed in Table 1. The number of taxa is greater than the actual number of species present, as adults and immatures of some species have been listed as separate taxa due to the lack of association of life stages. The checklist represents, in effect, a taxonomic appraisal of all families found within the QWT. The specific epithet of each new species has been assigned a genitalia preparation number unique to that species (eg. PT-2010 or CT-221) and such numbers will be included in future published descriptions.

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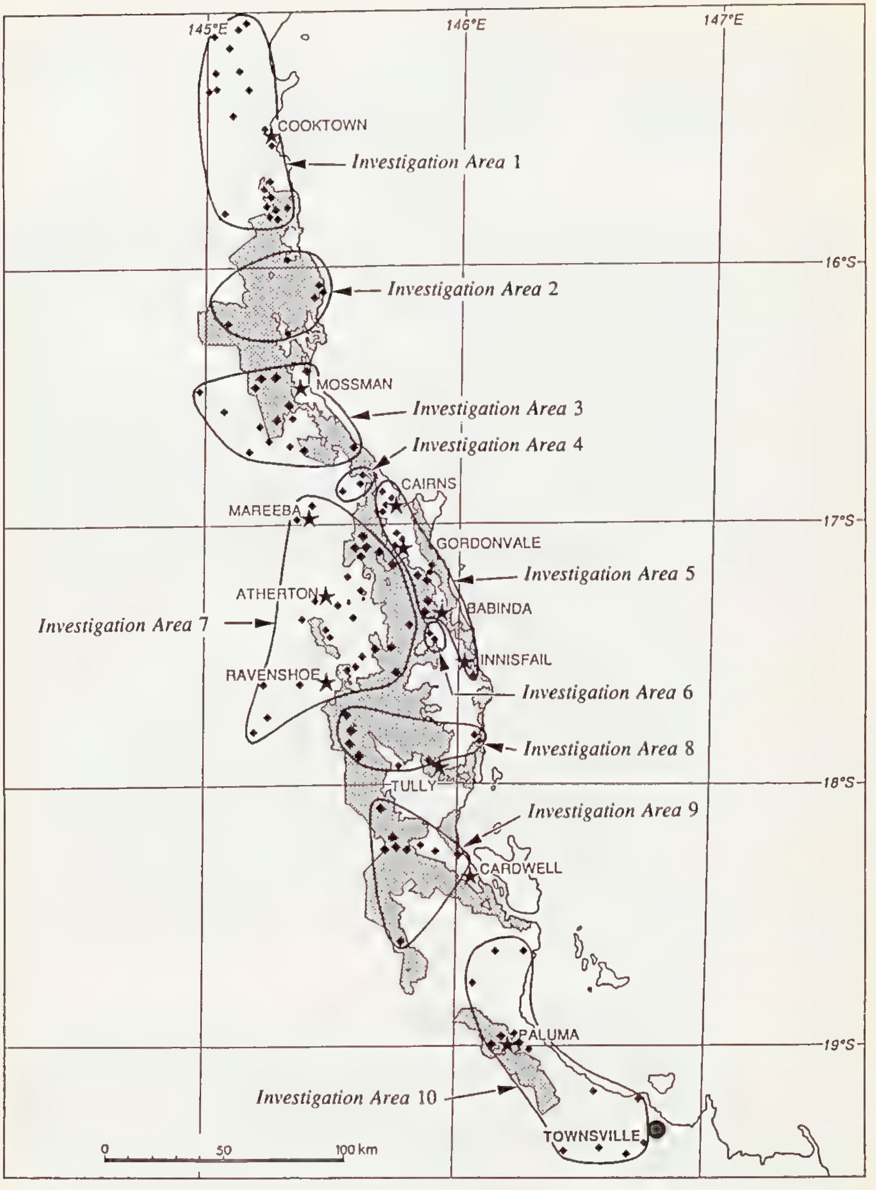

Fig. 1. Map of Queensland Wet Tropics, including the World Heritage Area (shaded) and showing collection sites (diamond symbols) and investigation areas (circled and numbered). Note: Star symbols mark major towns.

Table 1. Trichoptera species checklist for the Queensland Wet Tropics, with presence or absence within each investigation area noted. (Note: L - denotes taxa recorded as larvae only.)

INVESTIGATION AREAS	1	2	3	4	5	6	7	8	9	10
TRICHOPTERA										
Antipodoeciidae										
Antipodoecia turneri Mosely	+	-	-	-	+	-	-	-	+	+
Atriplectididae										
Atriplectides dubius Mosely	-	-	+	-	+	-	+	-	-	-
Atriplectides sp. nov. PT-2010	-	-	-	-	+	-	-	-	+	-
Calamoceratidae										
Anisocentropus banghaasi Ulmer	+	-	-	-	+	-	-	+	+	-
Anisocentropus kirramus Neboiss	+	-	+	-	+	+	+	-	+	+
Anisocentropus latifascia (Walker)	+	+	+	-	-	-	+	-	-	-
Anisocentropus semiflavus Banks	-	+	+	-	+	-	+	+	+	-
Anisocentropus sp. 1 (L)	+	-	-	-	+	-	+	+	-	-
Anisocentropus sp. 2 (L)	-	-	-	-	-	-	-	-	+	-
Anisocentropus sp. 3 (L)	+	-	+	-	+	-	+	+	+	+
Anisocentropus sp. 4 (L)	+	+	-	-	-	-	+	-	-	+
Anisocentropus torulus Neboiss	+	-	+	+	+	-	+	+	+	-
Anisocentropus spp. indet.	-	-	+	-	+	-	+	+	-	+
Calocidae										
Caenota galeata Neboiss	-	-	+	-	-	-	-	-	-	-
Caenota monteithi Neboiss	-	-	-	-	-	+	+	-	-	-
Caenota nemorosa Neboiss	-	-	+	+	+	-	+	+	+	+
Calocoides aquilonia Neboiss	+	+	+	-	+	-	+	-	+	-
Gen ? sp. A (L)	-	-	-	-	-	-	-	-	+	-
Gen ? sp. B (L)	-	-	+	-	+	-	-	-	-	-
Gen ? sp. C (L)	-	-	-	-	+	-	+	-	+	-
Gen ? sp. E (L)	-	-	-	-	+	-	+	-	-	-
Gen. nov. sp. F (L)	-	-	+	+	+	-	+	-	-	-
Pliocaloca dasodes Neboiss	+	-	-	-	-	+	-	-	-	-
Pliocaloca fastigiata Neboiss	-	-	-	-	-	+	+	-	-	-
Pliocaloca mucronata Neboiss	-	-	-	-	-	+	-	-	-	-
Conoesucidae										
Coenoria sp. nov. PT-2022	-	-	-	-	+	-	+	-	-	-
Coenoria sp. nov. PT-2041	-	-	+	-	-	-	-	-	-	-
Gen ? sp. D (L)	-	-	-	-	-	-	+	-	-	-
Dipseudopsidae										
Hyalopsyche disjuncta Neboiss	-	-	-	-	+	-	-	-	-	-
Ecnomidae										
Ecnomina sp. nov. CT-229	-	-	-	-	+	+	-	-	+	-
Ecnomina sp. nov. CT-230	-	-	-	-	-	+	-	-	-	-
Ecnomina sp. nov. CT-231	-	-	-	-	-	+	-	-	+	+
Ecnomina sp. nov. CT-232	-	-	-	-	-	+	-	-	-	-
Ecnomina sp. nov. CT-233	-	-	-	-	-	-	-	-	-	+

Table 1 (cont.). Trichoptera species checklist for the Queensland Wet Tropics, with presence or absence within each investigation area noted. (Note: L - denotes taxa recorded as larvae only.)

INVESTIGATION AREAS	1	2	3	4	5	6	7	8	9	10
Ecnomidae (cont.)										
Ecnomina sp. nov. CT-234	-	-	+	-	+	-	+	+	-	+
Ecnomina sp. nov. CT-235	-	-	-	-	+	-	-	-	-	-
Ecnomina sp. nov. CT-236	-	-	-	-	-	-	-	-	-	+
Ecnomina sp. nov. CT-237	-	-	-	-	-	-	-	+	-	-
Ecnomina sp. nov. D3 (L)	+	-	-	-	-	-	-	-	+	-
Ecnomina sp. nov. E2 (L)	-	-	-	-	-	-	-	-	+	-
Ecnomina sp. nov. F5 (L)	-	-	+	-	-	-	-	-	-	-
Ecnomina sp. nov. F6 (L)	-	-	-	-	-	-	-	-	+	-
Ecnomina sp. nov. PT-1590	-	-	-	-	-	-	-	-	+	-
Ecnomina sp. nov. PT-1591	-	-	-	+	+	-	-	-	+	+
Ecnomina sp. nov. PT-1592	-	-	-	-	-	-	-	-	+	+
Ecnomina sp. nov. PT-1651	-	-	-	-	-	-	-	+	+	+
Ecnomina spp. indet.	+	+	-	-	+	+	+	+	+	-
Ecnomus clavatus Cartwright	-	-	-	-	-	-	-	-	-	+
Ecnomus continentalis Ulmer	-	-	+	+	+	-	+	-	+	+
Ecnomus cuspidis Cartwright	-	-	-	-	-	-	+	-	-	+
Ecnomus kerema Cartwright	-	-	-	-	-	-	-	-	+	-
Ecnomus kinka Cartwright	-	-	+	-	-	-	-	-	-	+
Ecnomus kitabal Cartwright	-	-	-	-	+	-	-	-	-	-
Ecnomus larakia Cartwright	-	-	-	-	-	-	-	-	-	+
Ecnomus miriwud Cartwright	-	-	+	-	-	-	-	-	-	-
Ecnomus pilbarensis Cartwright	-	-	-	-	-	-	-	-	-	+
Ecnomus tropicus Cartwright	-	-	-	-	-	-	-	-	-	+
Ecnomus turrbal Cartwright	-	-	-	-	+	-	+	-	-	+
Ecnomus wagengugurra Cartwright	+	-	-	-	-	-	+	-	-	-
Ecnomus wellsae Cartwright	-	-	-	-	-	-	+	-	+	+
Ecnomus woronan Cartwright	-	-	-	-	-	-	-	-	-	+
Ecnomus spp. indet.	-	-	+	+	+	-	+	+	-	+
Glossosomatidae										
Agapetus sp.	-	-	-	-	-	-	-	+	+	-
Agapetus sp. nov. PT-2011	-	-	-	-	+	-	+	-	-	+
Agapetus sp. nov. PT-2025	-	-	-	-	+	-	-	-	-	-
Helicophidae										
Alloecella sp. nov. PT-2016	-	-	+	-	-	-	-	-	-	-
Helicopha sp. nov. PT-2019	+	-	+	-	-	-	+	-	+	+
Helicopsychidae										
Helicopsyche heacota Mosely	-	-	-	-	-	-	-	-	+	-
Helicopsyche sp. 5 (L)	-	+	-	-	-	-	-	+	-	-
Helicopsyche sp. 6 (L)	+	-	-	-	+	-	+	+	+	+
Helicopsyche sp. 7 (L)	+	-	-	-	-	-	-	+	-	-
Helicopsyche spp. indet.	+	+	+	+	+	+	+	+	+	+

Table 1 (cont.). Trichoptera species checklist for the Queensland Wet Tropics, with presence or absence within each investigation area noted. (Note: L - denotes taxa recorded as larvae only.)

INVESTIGATION AREAS	1	2	3	4	5	6	7	8	9	10
Hydrobiosidae										
Apsilochorema gisbum (Mosely)	+	+	-	-	-	-	+	+	+	-
Apsilochorema obliquum (Mosely)	-	+	+	-	+	+	+	-	+	+
Ethochorema brunneum (Mosely)	+	+	+	+	+	+	+	+	+	+
Ptychobiosis nigrita (Banks)	-	+	+	-	+	+	+	-	+	+
Ulmerochorema seona (Mosely)	-	-	+	-	-	-	-	-	-	-
Ulmerochorema stigma (Ulmer)	+	+	+	+	+	-	+	+	+	+
Ulmerochorema sp. nov. PT-1036	-	+	+	-	+	+	+	-	+	+
Hydropsychidae										
Aethaloptera sexpunctata (Kolenati)	-	-	-	-	+	+	-	+	-	-
Asmicridea sp.	-	+	-	+	+	+	+	+	+	-
Asmicridea sp. 4 (L)	-	-	+	-	+	-	+	+	-	-
Asmicridea sp. 5 (L)	+	+	-	-	+	-	+	-	-	-
Baliomorpha banksi (Mosely)	+	+	+	+	+	-	+	-	+	+
Cheumatopsyche sp. nov. 11 (L)	-	+	-	-	-	-	-	-	-	-
Cheumatopsyche sp. nov. 12 (L)	+	-	+	-	-	-	+	-	-	-
Cheumatopsyche sp. nov. 13 (L)	+	+	-	-	-	-	-	-	+	-
Cheumatopsyche sp. nov. 14 (L)	-	-	-	+	+	-	+	+	+	+
Cheumatopsyche sp. nov. 15 (L)	+	+	+	+	+	-	+	+	-	+
Cheumatopsyche sp. nov. 16 (L)	+	-	+	+	+	-	+	+	+	-
Cheumatopsyche sp. nov. 17 (L)	-	-	-	-	+	-	-	-	-	-
Cheumatopsyche sp. nov. 19 (L)	-	+	-	-	-	-	-	+	-	-
Cheumatopsyche sp. nov. 22 (L)	-	-	-	-	-	-	+	-	+	-
Cheumatopsyche spp. indet.	+	+	+	+	+	+	+	+	+	+
Diplectrona sp. nov. 7 (L)	-	-	+	+	-	-	+	+	+	-
Diplectrona sp. nov. 8 (L)	-	-	-	+	-	-	-	-	+	+
Diplectrona sp. nov. 10 (L)	-	-	-	-	+	-	+	-	-	-
Diplectrona sp. nov. PT-999	-	-	-	-	-	+	-	-	-	-
Diplectrona sp. nov. PT-1000	-	-	+	-	+	+	+	-	-	-
Diplectrona sp. nov. PT-1002	-	-	-	-	-	+	-	+	+	-
Diplectrona sp. nov. PT-1003	-	-	+	-	-	-	-	-	-	-
Diplectrona sp. nov. PT-1012	-	-	-	-	-	+	-	-	-	-
Diplectrona sp. nov. PT-1016	-	+	-	-	-	-	-	-	-	-
Diplectrona sp. nov. PT-1031	-	-	-	-	-	+	-	-	-	-
Diplectrona sp. nov. PT-1040	-	-	+	-	+	-	+	-	-	-
Diplectrona sp. nov. PT-2007	-	-	+	-	-	-	-	-	-	-
Diplectrona sp. nov. PT-2042	+	-	-	-	-	-	-	-	-	-
Macrostemum saundersii (McLachlan)	+	-	-	-	-	-	-	-	-	-
Smicrophylax sp. 5 (L)	+	-	+	-	-	-	-	+	+	-
Smicrophylax sp. 6 (L)	-	-	+	-	-	-	-	-	-	-
Smicrophylax ulmeri (Banks)	-	-	+	+	+	+	+	+	+	+
Smicrophylax spp. indet.	+	+	+	+	+	-	+	+	+	-

Table 1 (cont.). Trichoptera species checklist for the Queensland Wet Tropics, with presence or absence within each investigation area noted. (Note: L - denotes taxa recorded as larvae only.)

INVESTIGATION AREAS	1	2	3	4	5	6	7	8	9	10
Hydroptilidae										
Acanthotrichia bilamina Wells	-	-	-	-	-	-	-	-	+	+
Acritoptila capistra Wells	-	-	-	-	-	-	-	-	+	-
Acritoptila pearsoni Wells	-	-	-	-	-	-	-	-	+	-
Acritoptila sp. indet.	-	-	-	-	-	-	-	-	+	-
Chrysotrichia australis Wells	-	-	-	-	-	-	-	-	+	-
Gnathotrichia australiensis Wells	-	-	-	-	-	-	-	-	-	+
Hellyethira cornuta Wells	+	+	-	-	+	-	+	-	+	+
Hellyethira cubitans Wells	-	-	-	-	+	-	-	-	-	+
Hellyethira eskensis (Mosely)	-	-	-	-	+	-	+	-	-	+
Hellyethira imparalobata Wells	-	-	-	-	-	-	-	-	+	-
Hellyethira quadrata Wells	-	-	-	-	-	-	-	-	+	+
Hellyethira simplex Mosely	-	-	-	-	+	-	+	-	+	+
Hellyethira sp. nov.	-	-	-	-	-	-	-	-	-	+
Hellyethira sp. nov. A	-	-	-	-	-	-	-	-	-	+
Hellyethira spinosa Wells	-	-	-	-	-	-	-	-	+	-
Hellyethira vernoni Wells	-	-	-	-	+	-	-	+	+	+
Hellyethira spp. indet.	+	-	-	-	+	-	+	-	+	+
Hydroptila incertula Mosely	-	-	-	-	-	-	-	-	+	+
Hydroptila losida Mosely	-	-	-	-	-	-	-	-	+	+
Hydroptila obscura Wells	-	-	-	-	+	-	+	+	+	+
Hydroptila scamandra Neboiss	-	-	-	-	-	-	+	+	+	-
Hydroptila spp. indet.	+	-	-	-	-	-	-	-	-	+
Maydenoptila kurandica Wells	-	-	-	+	-	-	-	-	-	-
Mulgravia coronata Wells	-	-	-	-	-	-	-	-	+	-
Orphninotrichia silicis Wells	-	-	-	-	-	-	+	-	-	-
Orthotrichia bensoni Wells	-	-	-	-	-	-	-	-	+	-
Orthotrichia bullata Wells	-	-	-	-	+	-	-	-	-	+
Orthotrichia conferta Wells	-	-	-	-	+	+	-	-	+	-
Orthotrichia constricta Wells	-	-	-	-	-	-	-	-	+	-
Orthotrichia divaricata Wells	-	-	-	-	+	-	-	-	+	-
Orthotrichia morula Wells	-	-	-	-	+	-	+	-	-	-
Orthotrichia sp. nov. A (*aberrans* group)	-	-	-	-	-	-	-	-	-	+
Orthotrichia turrita Wells	-	-	-	-	-	-	-	-	-	+
Orthotrichia velata Wells	-	-	-	-	-	-	-	-	+	+
Orthotrichia spp. indet.	+	-	-	+	-	-	+	-	+	+
Oxyethira bogambara Schmid	-	-	-	-	-	-	-	-	+	-
Oxyethira columba (Neboiss)	-	-	-	-	-	-	-	-	+	+
Oxyethira complicata Wells	-	-	-	-	-	-	-	-	+	+
Oxyethira spp. indet.	+	-	-	-	-	-	-	+	+	+
Oxyethira triangulata Wells	-	-	-	-	+	-	+	+	+	+
Stenoxyethira plumosa Wells	-	-	-	-	+	-	-	-	-	-

Table 1 (cont.). Trichoptera species checklist for the Queensland Wet Tropics, with presence or absence within each investigation area noted. (Note: L - denotes taxa recorded as larvae only.)

INVESTIGATION AREAS	1	2	3	4	5	6	7	8	9	10
Hydroptilidae (cont.)										
Stenoxyethira sp. indet.	-	-	-	-	-	-	-	+	-	-
Tricholeiochiton fidelis Wells	-	-	-	-	-	-	-	-	-	+
Tricholeiochiton sp. indet.	-	-	-	-	-	-	-	-	-	+
Xuthotrichia ochracea Mosely	-	-	-	-	-	-	-	+	-	-
Leptoceridae										
Gen. indet. sp.	-	-	+	-	+	-	+	-	-	-
Lectrides varians Mosely	-	-	+	-	-	-	-	+	-	+
Leptocerus assimulans (Ulmer)	+	-	+	-	-	-	-	-	-	-
Leptorussa darlingtoni (Banks)	-	-	+	-	-	-	-	-	-	-
Notalina spp. indet.	+	+	+	-	+	-	+	+	+	+
Notoperata sp. nov. PT-2014	+	+	+	-	-	-	+	+	+	+
Oecetis australis (Banks)	-	-	-	+	+	-	+	-	-	+
Oecetis burtoni Neboiss	+	-	+	-	-	-	-	-	-	+
Oecetis complexa Kimmins	-	-	-	-	+	-	+	-	-	+
Oecetis epekeina Neboiss	-	-	-	-	-	-	+	-	-	-
Oecetis inscripta Kimmins	-	-	-	-	+	-	-	-	-	-
Oecetis laustra Mosely	-	-	+	-	+	-	+	-	+	+
Oecetis multipunctata Ulmer	-	-	+	+	+	-	+	+	-	-
Oecetis oresbiosa Neboiss	+	-	-	+	+	-	-	-	+	-
Oecetis piptona Neboiss	-	-	-	-	+	-	+	-	-	-
Oecetis spp. indet.	+	+	+	+	+	+	+	+	+	+
Setodes bracteatus Neboiss	-	+	-	+	+	-	+	+	+	+
Symphitoneuria exigua (McLachlan)	-	-	+	-	-	-	+	-	+	-
Triaenodes sp.	-	-	-	-	-	-	-	-	-	+
Triaenodes sp. nov. PT-659	-	-	-	-	+	-	-	-	-	-
Triaenodes sp. nov. PT-756	-	-	-	-	-	-	-	-	-	+
Triaenodes sp. nov. PT-757	-	-	-	-	-	-	+	-	-	-
Triaenodes sp. nov. PT-759	-	-	-	-	+	-	-	-	-	-
Triaenodes sp. nov. PT-761	-	-	-	-	-	-	+	-	-	-
Triaenodes sp. nov. PT-763	+	-	+	-	-	-	-	-	-	-
Triaenodes sp. nov. PT-764	+	-	+	-	+	+	-	-	-	-
Triaenodes sp. nov. PT-767	+	-	-	-	+	+	-	-	+	+
Triaenodes sp. nov. PT-783	+	-	-	+	+	-	+	-	-	+
Triaenodes sp. nov. PT-800	-	-	+	-	-	-	-	-	-	+
Triaenodes sp. nov. PT-1090	-	-	-	-	-	+	-	-	-	-
Triaenodes sp. nov. PT-1091	-	-	-	-	-	+	-	-	-	-
Triaenodes sp. nov. PT-1116	-	-	-	-	-	-	-	-	+	+
Triaenodes sp. nov. PT-1117	-	-	-	-	-	-	-	+	-	+
Triaenodes sp. nov. PT-1122	-	-	-	-	-	-	+	-	-	-
Triaenodes sp. nov. PT-2021	-	-	-	-	-	-	-	-	-	+
Triaenodes sp. nov. PT-2040	-	-	-	-	-	-	+	-	-	-

Table 1 (cont.). Trichoptera species checklist for the Queensland Wet Tropics, with presence or absence within each investigation area noted. (Note: L - denotes taxa recorded as larvae only.)

INVESTIGATION AREAS	1	2	3	4	5	6	7	8	9	10
Leptoceridae (cont.).										
Triaenodes spp. indet.	+	-	+	-	+	-	+	-	+	-
Triaenodes volda Mosely	-	+	+	-	+	-	+	-	+	+
Triplectides australicus Banks	-	-	-	-	+	-	-	-	-	-
Triplectides australis Navas	-	-	-	-	-	-	+	-	+	-
Triplectides ciuskus Mosely	-	-	-	-	+	-	+	-	-	+
Triplectides dolabratusa Morse & Neboiss	-	-	+	-	-	+	-	+	+	-
Triplectides elongatus Banks	-	-	+	-	+	-	-	-	-	-
Triplectides gonetalus Morse & Neboiss	-	+	+	-	+	-	+	+	+	+
Triplectides hamatus Morse & Neboiss	-	-	-	-	-	-	-	-	-	+
Triplectides helvolus Morse & Neboiss	-	-	-	-	-	-	+	-	-	-
Triplectides liratellus Morse & Neboiss	-	-	-	-	+	-	-	-	-	-
Triplectides liratus Morse & Neboiss	+	+	-	-	-	+	+	-	+	+
Triplectides parvus (Banks)	+	-	-	+	+	-	+	-	+	+
Triplectides prolatus Morse & Neboiss	-	-	+	+	+	-	+	-	-	-
Triplectides rossi Morse & Neboiss	-	-	-	-	-	+	+	-	+	-
Triplectides similis Mosely	-	-	-	-	-	-	+	-	-	-
Triplectides spp. indet.	+	+	+	+	+	+	+	+	+	+
Triplectides tambina Mosely	-	-	-	-	-	-	-	-	-	+
Triplexa sp. nov. PT-1762	-	-	-	+	-	-	-	-	+	-
Westriplectes angelae Neboiss	-	-	-	-	+	-	-	-	-	-
Odontoceridae										
Barynema sp. nov. PT-1176	+	-	-	-	-	-	-	-	-	-
Barynema sp. nov. PT-1405	-	-	+	-	+	-	+	+	+	-
Barynema sp. nov. PT-2028	-	-	-	-	-	-	+	-	-	-
Marilia bola Mosely	+	-	+	-	-	-	+	-	+	-
Marilia fusca Kimmins (L)	-	-	-	-	-	-	+	-	-	-
Marilia spp. indet.	+	+	+	+	+	+	+	+	+	+
Philopotamidae										
Chimarra australica (Ulmer)	-	-	+	+	+	+	+	-	+	-
Chimarra monticola Kimmins	+	-	+	-	+	-	+	-	+	-
Chimarra sp. nov. 6 (L)	-	-	-	-	+	-	-	-	-	-
Chimarra sp. nov. 7 (L)	+	-	+	-	+	-	+	+	+	-
Chimarra sp. nov. 11 (L)	-	-	-	-	-	-	-	-	+	-
Chimarra sp. nov. CT-221	-	+	-	-	+	+	-	+	-	+
Chimarra sp. nov. CT-223	+	+	-	-	+	-	+	+	+	-
Chimarra sp. nov. CT-225	-	-	+	-	+	-	+	-	+	-
Chimarra sp. nov. CT-226	-	-	-	-	-	-	-	-	-	+
Chimarra sp. nov. CT-227	-	-	-	-	-	+	-	-	-	-
Chimarra sp. nov. CT-228	-	-	-	-	-	+	-	-	-	-
Chimarra spp. indet.	+	-	+	-	+	+	-	+	+	+
Chimarra uranka Mosely	+	+	+	+	+	-	+	+	+	+

Table 1 (cont.). Trichoptera species checklist for the Queensland Wet Tropics, with presence or absence within each investigation area noted. (Note: L - denotes taxa recorded as larvae only.)

INVESTIGATION AREAS	1	2	3	4	5	6	7	8	9	10
Philopotamidae (cont.)										
Gen. nov. sp. nov. PT-1640	-	-	-	-	+	-	-	-	+	-
Hydrobiosella sp. nov. 15 (L)	-	-	+	+	+	-	+	-	+	+
Hydrobiosella sp. nov. PT-1037	-	-	-	-	-	+	-	-	-	-
Hydrobiosella sp. nov. PT-1038	-	-	-	-	-	+	-	-	-	-
Hydrobiosella sp. nov. PT-1039	-	-	-	-	-	+	-	-	-	-
Hydrobiosella sp. nov. PT-1768	-	-	-	+	+	-	+	+	-	+
Hydrobiosella sp. nov. PT-2029	-	-	-	-	-	-	-	-	-	+
Hydrobiosella spp. indet.	-	-	-	-	-	+	+	-	+	+
Philorheithridae										
Aphilorheithrus sp. nov. PT-2038	-	-	+	-	-	-	-	+	+	+
Gen. Nov. P sp. nov. PT-1707	-	-	-	-	-	+	-	-	-	-
Gen. Nov. Q sp. nov. PT-1837	-	-	+	-	+	-	-	+	+	+
Polycentropodidae										
Gen. G sp. 1 (L)	-	-	-	-	-	-	+	-	-	-
Paranyctiophylax sp. nov. 5 (L)	-	-	-	-	-	-	-	-	+	-
Paranyctiophylax sp. nov. 7 (L)	-	-	-	-	-	-	-	-	+	-
Paranyctiophylax sp. nov. PT-1589	-	-	-	-	-	-	-	-	+	+
Paranyctiophylax sp. nov. PT-1625	-	-	-	-	-	-	-	-	+	-
Paranyctiophylax sp. nov. PT-1977	+	-	+	-	+	-	+	-	-	-
Paranyctiophylax sp. nov. PT-1979	+	-	+	-	+	-	+	-	+	-
Plectrocnemia sp. nov. PT-1817	+	-	+	-	+	-	+	-	+	+
Plectrocnemia sp. nov. PT-1822	-	-	+	-	-	+	+	-	+	+
Plectrocnemia sp. nov. PT-1976	-	-	-	-	-	-	-	-	+	-
Plectrocnemia spp. indet.	+	-	+	-	-	-	+	-	+	+
Polyplectropus sp. 2 (L)	-	-	+	-	-	-	+	-	+	-
Polyplectropus sp. 3 (L)	-	-	-	-	-	-	-	-	+	+
Polyplectropus sp. nov. PT-1821	-	-	+	+	+	+	+	+	+	-
Psychomyiidae										
Tinodes radona Neboiss	+	-	-	-	-	-	-	-	-	-
Zelandoptila yuccabina Neboiss	-	-	-	-	-	-	-	-	+	-
Stenopsychidae										
Stenopsychodes mjobergi Ulmer	+	-	+	+	+	+	+	+	-	+
Stenopsychodes sp. nov. A	-	-	-	-	-	+	-	-	+	-
Stenopsychodes sp. nov. B	-	-	-	-	-	+	-	-	+	-
Stenopsychodes sp. nov. C	-	-	+	-	+	+	+	+	+	-
Stenopsychodes sp. nov. D	-	-	-	-	-	+	-	-	-	-
Stenopsychodes sp. nov. E	-	-	-	-	-	+	-	-	-	-
Stenopsychodes sp. nov. F	-	-	-	-	-	+	-	-	-	-
Stenopsychodes spp. indet.	+	+	+	-	+	+	+	+	+	+
Tasimiidae										
Tasiagma sp.	-	-	-	-	-	-	+	+	-	-

A taxonomic summary of the QWT Trichoptera fauna is presented in Table 2. In total 217 species have been recognised, of which 95 species and four genera are undescribed. The highest number of species recorded at an individual site was 78 at Yuccabine Creek, while the 10 most specious sites yielded an average of 41.8 species.

Table 2. Taxonomic evaluation of the Queensland Wet Tropics Area Trichopteran fauna.

Total number of species:	217
Taxa identified from adult material:	202
Taxa identified from immature material:	79
Immature taxa clearly different from adult taxa:	15
Immature taxa associated with adults:	30
Immature taxa not associated with adults:	49
New species recognised:	95
New genera recognised:	4
New species based on adult material only:	83
New species based on immature material only:	12

The PATN analyses were performed separately on the adult and immature data (for full details see Walker *et al.* 1993). As expected, the larger adult data set provided better resolution between the investigation areas, although results from immatures supported those obtained for adults. The analyses separated the investigation areas into three groups, each with a distinctive faunal composition. Investigation areas 9 and 10 were grouped, investigation area 6 was unique and there were no significant faunal differences between the remaining seven investigation areas.

Discussion

Comparison of the trichopteran faunas of Australia, the Queensland Wet Tropics and the Tasmanian World Heritage Area (Table 3) indicates: higher species richness in the QWT, with 36.7% of the known Australian fauna, compared to 22.7% occurring in the TWHA; QWT has a higher maximum number of species occurring at an individual site and within a single Investigation Area than has the TWHA; the QWT has a similar number of families and genera as the TWHA, though the family composition differs between the two areas. Families present in the QWT and not found in the TWHA are Antipodoeciidae, Dipseudopsidae (formerly Hyalopsychidae: Wells and Cartwright, 1993a), Odontoceridae, Psychomyiidae, Calamoceratidae and Stenopsychidae. Families present in the TWHA and not found in the QWT are Kokiriidae, Limnephilidae, Oeconesidae and Plectrotarsidae.

Table 3. Comparison of the trichopteran faunas of Australia (AUS), the Queensland Wet Tropics (QWT) and the Tasmanian World Heritage Area (TWHA) (Note: In calculating the numbers of species, immature and 'spp. indet.' taxa were excluded if it was likely that they were conspecific with listed adult species; undescribed species and genera, recorded from the QWT, have been included in the total number of known Australian taxa. Sources of species composition: AUS- Neboiss, 1991, 1992; Wells, 1990; TWHA- Neboiss, Jackson & Walker, 1989).

	AUS	QWT	TWHA
Number of known families:	26	21	19
Number of known genera:	106	67	62
Number of known species:	590	217	134
Highest number of species within an Investigation Area:	-	100	91
Highest number of species at a single site:	-	78	45
Number of species in the 10 most specious Australian families:			
Hydroptilidae	121	39	10
Leptoceridae	102	51	28
Ecnomidae	67	24	5
Hydrobiosidae	58	7	26
Hydropsychidae	46	26	5
Philopotamidae	32	16	7
Conoesucidae	23	2	15
Calocidae	19	8	5
Philorheithridae	16	3	8
Calamoceratidae	10	5	0

The species richness within investigation areas of the QWT is remarkably high, with seven investigation areas yielding 50 or more species. Species richness observed at many sites was greater than recorded in southern Australia from the Tasmanian World Heritage Area (Neboiss *et al.* 1989). The average number of species for the ten most diverse sites in the two World Heritage Areas was 41.8 species for the QWT and 37.0 species for the TWHA. The highest number of species recorded at an individual site within the QWT was at Yuccabine Creek (78 species). This site exceeded the richest TWHA site, which yielded 45 species (Franklin River, Roaring Creek Junction) and also the 44 species recorded from the O'Shannassy River in Victoria (Dean and Cartwright 1987) and the 47 species recorded from Gunshot Creek, Cape York Peninsula (Wells and Cartwright 1993b). It should be noted that the species lists for Yuccabine Creek (Benson and Pearson 1988) and O'Shannassy River were the result of extensive collecting programs; lower species numbers at other sites may merely reflect a lesser

collecting effort. There is therefore evidence that Trichoptera species richness is probably greater in the QWT than in other areas of Australia.

While it is difficult to quantify the definition of a rare species, a qualitative assessment of the conservation status of taxa within the QWT has been attempted. For the purposes of this study, we have developed the following definitions:

- a species is defined as "rare" when known from less than four specimens;
- a species is defined as "localised" when known only from a single site;
- a species is defined as "vulnerable" when known from a single site and less than four specimens.

Using the above definitions, the conservation status of the Trichoptera fauna of the QWT is as follows:

- 52.1% (113 species) of the QWT Trichoptera fauna is "rare";
- 30.0% (65 species) of the QWT Trichoptera fauna is "localised";
- 22.1% (48 species) of the QWT Trichoptera fauna is "vulnerable";
- .77.1% (37 species) of the "vulnerable" fauna is presumed to be endemic to the QWT based on current knowledge.

Of the 113 species defined as rare, 54 species have been recorded from one or more of the three sites, Yuccabine Creek, Bellenden Ker Range and Birthday Creek Falls. Furthermore, these three sites have yielded 27 of 65 species known from single sites only and 18 of 48 species defined as vulnerable. On the basis of current information, these sites are worthy of special conservation consideration.

Although the Australian Trichoptera fauna is reasonably well known, it is significant that 43.8% of the species recorded from the QWTA are new to science. This demonstrates the value of involving taxonomic experts at an early stage of any faunal survey. Table 2 also highlights the disparity between knowledge of the adult and immature stages. While 202 of 217 recognised species (93.1%) were based on adult specimens, only 15 of 217 recognised species (6.9%) were based solely on immature specimens. Furthermore, of the 202 species recognised from adult material, only 30 species (14.9%) were associated with larvae. In fact, the larvae of more than half the total known species from the QWTA have not yet been collected, let alone associated with adults.

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